

ALUMINUM

INDUSTRY OF THE FUTURE

VISION:

TO MAINTAIN AND GROW
THE ALUMINUM INDUSTRY
THROUGH THE MANUFACTURE
AND SALE OF
COMPETITIVELY PRICED,
SOCIALY DESIRABLE,
AND ECOLOGICALLY
SUSTAINABLE PRODUCTS.

PARTNERSHIPS FOR
THE FUTURE
THE ALUMINUM ASSOCIATION



*Aligning technology
investments to meet
aluminum industry and
national goals*



OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

THE VISION

Industry vision provides framework for cooperative R&D

For over a century, the U.S. aluminum industry has led the global market with advances in technology, product development, and marketing. Industry leaders recognize both the opportunities and challenges they face as they head into the 21st century, and that cooperative R&D is key to their success.

In a unique partnership, aluminum industry leaders have teamed with the U.S. Department of Energy's Office of Industrial Technologies (OIT) to focus on innovative technologies that will help to strengthen the competitive position of the U.S. aluminum industry and, at the same time, further important national goals. This industry-led partnership, the Aluminum Industry of the Future, promotes technologies that optimize the use of energy and materials in operations and reduce wastes and energy-related emissions.

Partnerships for the Future

Led by The Aluminum Association, industry leaders began by developing a unified vision of future market, business, energy, and environmental goals. Their vision document, *Partnerships for the Future*, articulates a compelling vision for the next 20 years: to maintain and grow the aluminum industry through the manufacture and sale of competitively priced, socially desirable, and ecologically sustainable products.

Continued global leadership in materials markets will require the combined resources of industry, universities, and government laboratories. By developing a unified vision, the aluminum industry has provided a framework for the next step in the Industries of the Future process, the development of a technology roadmap designed to facilitate cooperative R&D.

THE ROADMAP

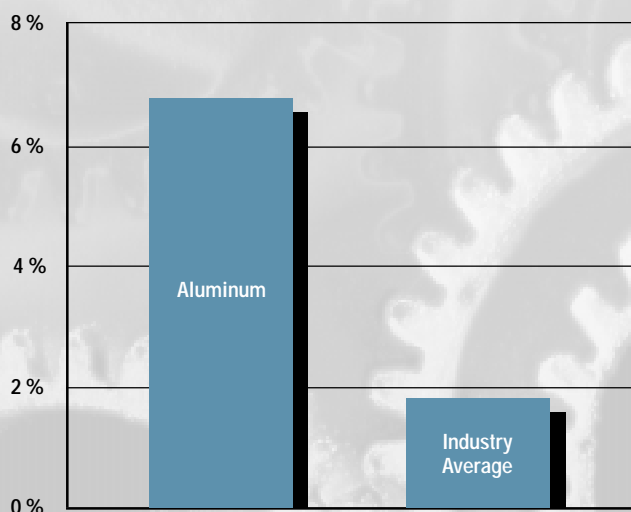
Roadmaps define technology priorities and performance targets

Developed through a highly interactive process led by the Technical Advisory Committee of The Aluminum Association, the Aluminum Industry Technology Roadmap outlines a strategy for achieving the goals established in the industry vision (see www.oit.doe.gov/aluminum). The roadmap establishes a focused R&D agenda, identifying the technologies required to make the vision a reality and setting specific technology performance targets.

By articulating its technology strategy, the U.S. aluminum industry hopes to motivate companies, the academic community, and other Federal agencies to align their research efforts with the high-priority needs identified by industry. The roadmap identifies 86 priority research thrusts required to meet performance targets. Research projects may be funded through single companies, industry collaborations, or industry-government partnerships. OIT selectively co-funds projects that address its mission of improving energy efficiency and preventing pollution.

ENERGY EXPENDITURES

Energy cost as a percent of sales, 1995



Source: Department of Commerce, 1996

Compared to other industries, the aluminum industry spends a much larger portion of its product costs on energy. These high-energy costs divert capital away from investments in technology and production. Reducing energy use and costs can help to dramatically improve the productivity and cost-effectiveness of aluminum manufacturing.



Selected high-priority research needs

The roadmap reflects the needs of the total industry, including primary and secondary aluminum producers, manufacturers of semifabricated products, and end-use customers, as well as the research community.

PRIMARY MATERIALS

The primary materials sector will be strengthened by further improvements in energy, operating, and environmental efficiencies. Increased recycling—key to future growth of the industry—will depend on advanced scrap separation and remelting processes and on integrating product and process design to maximize the value and usability of scrap and postconsumer metal products.

CASTING, ROLLING, AND EXTRUSION

Advanced manufacturing processes are key in this sector. For example, spray forming and other continuous casting processes promise to yield higher performance aluminum sheet at lower production costs. Development of net-shape production processes will reduce both energy inputs and process waste.

FINISHED PRODUCTS

Key to increased use of aluminum in end-use products will be development of customer-tailored engineering materials that combine the unique advantages of aluminum with other materials. Enabling technologies such as enhanced joining and forming processes will increase the cost-effective application of aluminum alloys and composite structures.

Addressing future developments

The Aluminum Industry Technology Roadmap will be revised and updated periodically to reflect changing market and technical issues and to ensure that the research priorities remain relevant to customer needs. Two other aluminum-related roadmaps address inert anodes and use of the material in the auto industry.

ALUMINUM INDUSTRY OF THE FUTURE

Novel public-private partnerships

The Industries of the Future process is driven by industry. Through technology roadmaps, industry participants set technology priorities, assess the progress of R&D, and ultimately lead the way in using the results. This new approach to private-public partnerships ensures the most strategic allocation possible of limited resources for the development of new technologies.

Based on industry's request, OIT's role is to help facilitate the Industries of the Future process and to support the development and deployment of technologies that will shape the future of the aluminum industry. Part of this role is to encourage industry to undertake long-term, sector-wide technology planning and to selectively co-invest with OIT in collaborative R&D efforts that match OIT's Federal mission.

Through this partnership, OIT provides streamlined access to the resources and capabilities of the National Laboratories and other Federal programs that share interests with the aluminum industry. Supporting this streamlined access is the Laboratory Coordinating Council (www.oit.doe.gov/lcc/lccintro.html), which produces detailed documentation of current and past research projects and laboratory capabilities that correspond to aluminum technology needs.

TAKING ACTION BASED ON INDUSTRY'S VISION

STEP 1: VISION

Under the leadership of the Aluminum Association, the aluminum industry published *Partnerships for the Future*, which defines its 20-year vision of how to maintain and build the competitive position of the U.S. aluminum industry.

STEP 2: TECHNOLOGY ROADMAP

The aluminum industry developed a detailed technology roadmap outlining the requirements for achieving industry goals and a focused R&D agenda.

STEP 3: R&D PARTNERSHIPS

Research is conducted through collaborative partnerships composed of private companies, suppliers, trade associations, National Laboratories, private research institutions, and government agencies.

ENHANCED COMPETITIVENESS

Industry of the Future projects advance aluminum vision

Through the Industries of the Future process, aluminum industry leaders can ensure the most strategic possible allocation of limited resources for technology development. The process encourages companies, the academic community, and National Laboratories to re-focus their research efforts to conform with the needs of the industry. OIT selectively co-funds R&D efforts, targeting potentially high-payoff technologies where risks are too high or results too long-term to attract adequate private-sector investment.



The following projects represent a sampling of the Aluminum Industry of the Future initiatives currently under way.

Spray forming of aluminum sheet

Industry and academia are partnering to develop an innovative spray-forming technology that will require fewer process steps, reduce energy and processing costs, and produce a metallurgically superior product compared to that produced by alternative forming technologies.

PARTNERS

Air Products & Chemicals
Aluminum Company of America
Carnegie Mellon University
Massachusetts Institute of Technology
Olin Corporation
Osprey Metals
University of California-Irvine

Inert anode/cathode systems for aluminum smelting

Project partners are working to combine inert oxygen-evolving anode and aluminum-wettable cathode systems for a more energy-efficient, productive, and environmentally friendly cell operation.

PARTNERS

Advanced Refractory Technologies
Aluminum Company of America
Kaiser Aluminum and Chemicals Company
Reynolds Metals Company

Recycling aluminum salt cake

Joint efforts to recycle aluminum salt cake focus on two key goals. The first goal is to develop a cost-effective process to separate salt cake into its constituents and recycle the aluminum and salt fractions to secondary aluminum smelters. The second goal is to convert the nonmetallic product to value-added alumina products.

PARTNERS

Alumitech, Inc.
Argonne National Laboratory

The Industries of the Future process enables competitors, suppliers, and customers to work together to solve precompetitive problems. This approach reduces the cost and risk of R&D.

Innovative flotation melter for scrap aluminum

The development of an innovative vertical flotation melter will significantly decrease the amount of energy required for processing scrap aluminum, as well as the associated emissions. When combined with the high-efficiency aluminum scrap decoating system also discussed on this page, it will significantly increase the overall efficiency of secondary aluminum smelting.

PARTNERS

Energy Research Company
Gillespe & Powers
IMCO Secondary Smelters
Stein Atkinson, Stordy

Aluminum scrap-melting oxygen-enhanced combustion

Project partners are working to develop and demonstrate a novel high-efficiency, low NOx combustion system integrated with innovative vacuum-swing-absorption oxygen generation. This integrated burner/ oxygen supply system will offer enhanced productivity, high energy efficiency, low operating costs, and low NOx emissions.

PARTNERS

Air Products & Chemicals, Inc.
Argonne National Laboratory
Brigham Young University
Roth Brothers

Converting spent potliner to useful glass fiber products

This project will evaluate the feasibility of converting spent potliner (SPL) from aluminum smelting plants to commercial quality glass fiber and aluminum fluoride products using Vortec's Cyclone Melting System technology. The conversion of SPL waste into a useful product has the potential to significantly reduce SPL disposal costs, eliminate the need for treatment and landfilling of SPL, and increase energy savings.

PARTNERS

Alumax Primary Aluminum Corporation
Hoogovens Technical Services, Inc.
New York State College of Ceramics at Alfred University
Vortec Corporation

Detection and removal of molten salts from molten aluminum

Chloride salts, which cause defects in aluminum ingots and castings, will be detectable through a simple electrical probe and will be selectively removed from the liquid metal through a new filter, both of which were created by Selee Corporation. This project will be able to eliminate melt rejection and recasting due to salt contamination, as well as reduce chlorine use and release.

PARTNERS

Aluminum Company of America's Technical Center
Selee Corporation

Case Studies

High-efficiency aluminum scrap decoating system doubles secondary smelter recycling efficiency and yield

This new high-efficiency rotary kiln decoating system strips away paint, plastics, oil, and other organic contaminants from aluminum scrap and uses their energy values to contribute to its own process heat. This system is projected to cut decoating energy costs in half. Since the fumes are used as fuel, hazardous environmental emissions are reduced and disposal costs avoided.

Because the process decreases by-product dross and dust formation, which remain as usable metal, it doubles the plant's decoating stock yield, valued annually at several million dollars. It also permits a much wider range of recycled scrap to be treated, ranging from fragmented engine blocks, to window frames, to microns-thin, foil-paper laminates.

Benefits

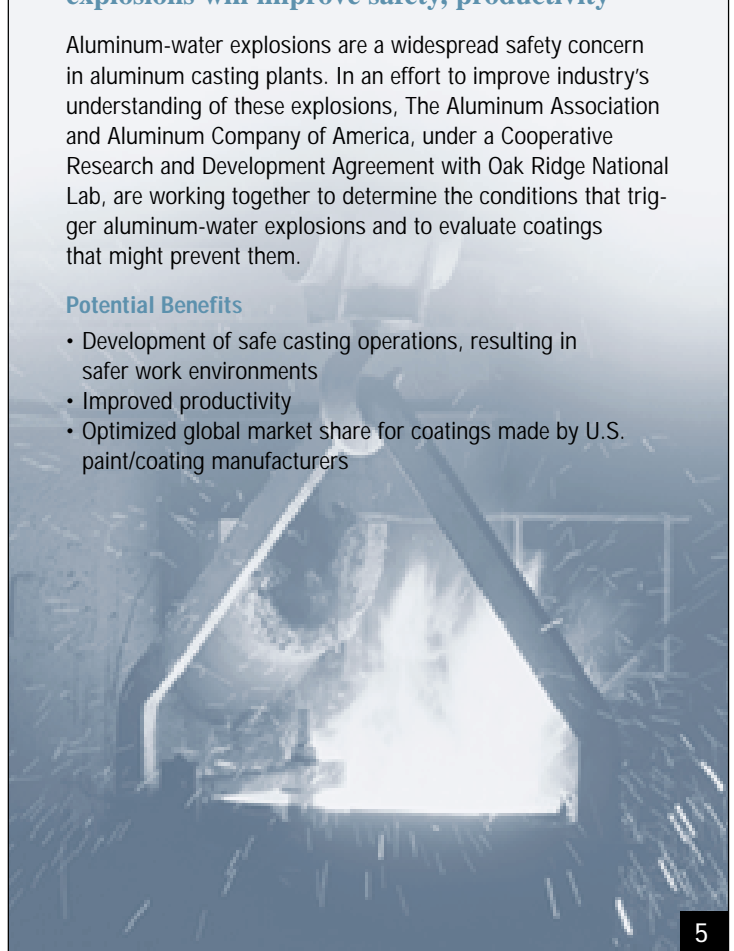
- Uses energy values of stripped contaminants for process heat
- Cuts hazardous environmental emissions and disposal costs
- Diminishes metal loss and dross formation
- Permits much wider range of recycled scrap to be treated

Prevention of molten aluminum-water explosions will improve safety, productivity

Aluminum-water explosions are a widespread safety concern in aluminum casting plants. In an effort to improve industry's understanding of these explosions, The Aluminum Association and Aluminum Company of America, under a Cooperative Research and Development Agreement with Oak Ridge National Lab, are working together to determine the conditions that trigger aluminum-water explosions and to evaluate coatings that might prevent them.

Potential Benefits

- Development of safe casting operations, resulting in safer work environments
- Improved productivity
- Optimized global market share for coatings made by U.S. paint/coating manufacturers



DOE programs support Aluminum Industry of the Future

OIT's Industries of the Future strategy accelerates R&D of novel technologies of interest to eight energy-intensive industries: aluminum, chemicals, forest products, glass, metalcasting, mining, renewable bioproducts, and steel. The strategy is sponsored and facilitated by OIT, a unit of DOE's Office of Energy Efficiency and Renewable Energy. Focus is on developing high-risk, high-payoff precompetitive technologies within a 20-year planning time frame.

As an integral component of the Aluminum Industry of the Future strategy, OIT offers a range of programs that can help the aluminum industry begin saving energy, reducing costs, and cutting pollution right away. Using an "integrated delivery" approach, OIT focuses on making an individual company aware of all the potentially applicable technologies, tools, and expertise in the organization's extensive portfolio of products and services and then providing the right services to meet the customer's needs.

Enabling Technologies

AIM (Advanced Industrial Materials) develops and commercializes new and improved materials to increase energy efficiency, improve productivity, and enhance material longevity and product quality.

The **Combustion** program increases productivity, improves energy efficiency, reduces emissions, and enhances fuel flexibility by developing cost-effective and energy-efficient technologies that are necessary for global competitiveness.

Continuous Fiber Ceramic Composite Materials pursues ceramic composite technologies that improve productivity by utilizing higher process temperatures, extending component and system lifetimes, and reducing downtime.

Sensors & Controls develops and deploys integrated measurement systems for operator-independent control of the manufacturing process. Priority goals are improving technology both in sensors embedded in high temperatures and harsh environmental applications, and in information processing to detect and remedy malfunctions.

Motor Challenge program helps Alumax save big on energy costs

Through OIT's Motor Challenge program, Alumax, Inc., explored ways to improve the energy efficiency of its four potline dust collection systems at its Mount Holly, South Carolina, plant. Alumax measured fan speed, air temperature, air flow, static pressure, and fan motor power consumption under three different scenarios. Selected as a Motor Challenge Showcase Demonstration site, this plant discovered that shutting off one of four fans in each potline fume-collection system netted an annual energy savings of more than \$103,000.

Potential Benefit

- Annual energy cost savings of \$103,000

Immersion tubes increase efficiency, reduce contamination, and enhance productivity

Textron Systems is leading an industrial team in the development of materials and processing methods for fabricating tubular ceramic composites that are reinforced with continuous silicon carbide fiber.

The ceramic fiber reinforced tubular heating elements used in holding furnaces at aluminum casting facilities to keep the hot aluminum molten are extremely tough and durable. This allows them to be immersed in the metal rather than suspended above it, increasing efficiency, allowing for more uniform heating, reducing the potential for contamination, and resulting in less down time when compared with the use of monolithic ceramic tubes.

Potential Benefits

- Decreased energy use as a result of efficient heat transfer and increased product yield
- Reduced fuel usage and emissions
- Enhanced overall quality improvement due to fewer rejected castings

Distributed Generation Technologies

Cogeneration improves the efficiency of fuel use and reduces overall emissions. This program supports extensive research, development, and demonstration to meet the technical and market challenges associated with enhancing industrial cogeneration and moderate-size independent power production opportunities.

Financial Assistance

The **Inventions & Innovation** program provides financial assistance for establishing technical performance and conducting early development of innovative ideas and inventions. Ideas with potential for significant energy savings and commercial use are chosen for financial support through a competitive solicitation process. Technical guidance and commercialization support are offered to successful applicants.

NICE³ (National Industrial Competitiveness Through Energy, Environment, Economics) is an innovative cost-sharing program that promotes energy efficiency, clean production, and economic competitiveness in industry by providing funding to State and industry partnerships for technology demonstration projects.

Technical Assistance

Combined Heat & Power Challenge is focused on overcoming major barriers that currently exist in implementing combined heat and power systems, including complex and costly environmental permitting, unclear environmental regulations, excessive utility fees and rates, and long and varied Federal tax depreciation schedules.

Compressed Air Challenge is dedicated to improving the efficiency and performance of industrial compressed air systems with the goal of reducing energy use and costs.

IACs (Industrial Assessment Centers) help small and medium-size manufacturers identify opportunities to improve productivity, reduce waste, and save energy through comprehensive industrial assessments. Teams of engineering professors and students from 30 universities across the country conduct the assessments and provide recommendations to manufacturers at no cost.

Motor Challenge helps increase the productivity and reliability of electric-motor-driven systems, reduce energy costs, and improve the bottom line by providing reliable, unbiased information, tools, and technical assistance to improve motor system efficiency.

Steam Challenge provides information tools and technical assistance that can help industry enhance productivity, lower production costs, and reduce emissions of its industrial steam systems.

Additional information resources include:

IPLocator (www.oit.doe.gov/locator) provides access to information on federally sponsored R&D projects that are ongoing or recently completed, optimizing the complementary research and development strengths of industry, universities, National Laboratories, and government.

OIT's Resource Catalog, available by calling 202-586-2090, describes over 400 publications and other information products of interest to our customers.

HOW TO GET INVOLVED

Turning vision into reality

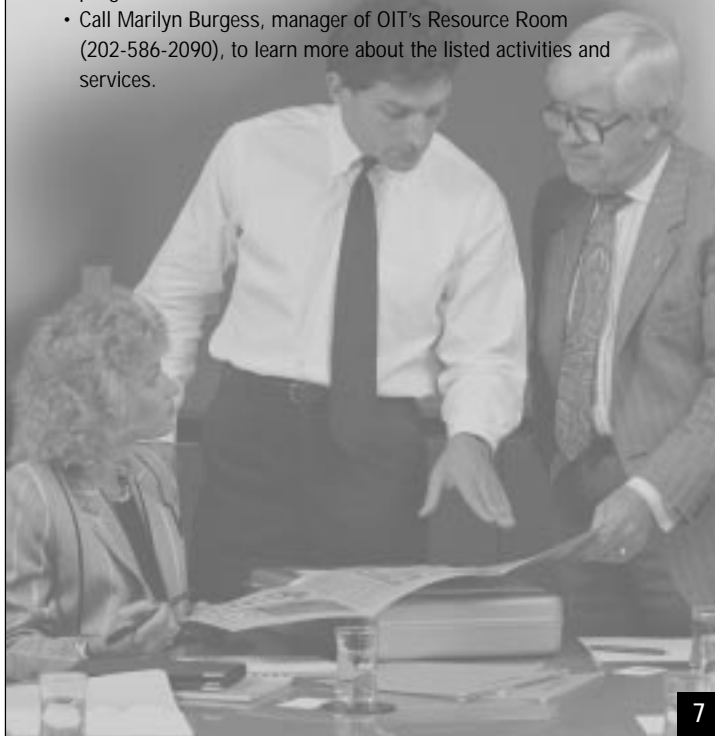
For U.S. aluminum companies, Industry of the Future partnerships can bring clear competitive advantages. Participating aluminum companies benefit from the reduced cost and risk of collaborative R&D and streamlined access to Federal scientific resources. Positioned at the forefront of technology development, these companies reap the benefits of more efficient and productive technologies and, in turn, contribute to our Nation's energy efficiency, industrial competitiveness, and environmental quality.

Ways to participate

By aligning R&D resources within industry and government to meet industry priorities, the Aluminum Industry of the Future will be poised to compete more effectively than ever in the global market.

There are many ways to participate:

- Monitor our Web pages for news and announcements of R&D solicitations (www.oit.doe.gov/IOF/aluminum).
- Team with other organizations and respond to solicitations for cost-shared research issued by OIT's Aluminum Industry of the Future team, our Enabling Technologies programs, and our Financial Assistance programs.
- Begin saving energy, reducing costs, and cutting pollution in your plant today by participating in any of the Technical Assistance programs.
- Call Marilyn Burgess, manager of OIT's Resource Room (202-586-2090), to learn more about the listed activities and services.



For more information on
the Aluminum Industry of
the Future, contact:

Sara Dillich
U.S. Department of Energy
Office of Industrial Technologies
1000 Independence Avenue, SW
Washington, DC 20585-0121
202-586-7925
saradillich@ee.doe.gov

The Aluminum Association
900 19th Street, NW
Washington, DC 20006
202-862-5100

Please send any comments,
questions, or suggestions to
webmaster.oit@hq.doe.gov

Visit the OIT Web site at
www.oit.doe.gov

U.S. Department of Energy

Office of Energy Efficiency
and Renewable Energy



Office of Industrial Technologies

November 1998